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HYGIENIC MEASURES
IN RELATION TO
INFECTIOUS DISEASES

NUTTALL

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HYGIENIC MEASURES

IN

RELATION TO INFECTIOUS DISEASES

COMPRISING IN CONDENSED FORM

INFORMATION AS TO THE CAUSE AND MODE OF SPREADING OF CERTAIN DISEASES, THE PREVENTIVE MEASURES THAT SHOULD BE RESORTED TO, ISOLATION, DISINFECTION, ETC.

BY

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PREFACE.

IN this little book an attempt has been made to place in condensed and consultable form definite and trustworthy information as to the cause of certain infectious diseases, how infection spreads, the length of time the specific agent may remain virulent, both in a dry and moist state and resist thermal and chemical disinfection, and putrefaction. Based upon such information, measures for the prevention of the spread of the disease through isolation and disinfection are given. Directions as to precautions which are to be observed in particular diseases as usually given are vague, inadequate, or inaccessible, and, what is more, ideas on the subject have of late undergone a material change. General principles are laid down in a short introduction on disinfectants

and disinfection which precedes the more detailed directions relating to each disease. Only such disinfectants and methods of disinfection have been considered as have been proved to be of practical value.

A number of authors have been consulted,[1] and the suggestions embodied in their writings and such results of experimentation which were thought most valuable utilized. It has been deemed inadvisable to burden the text with quotations. It is to be hoped that the information contained in this book will prove of practical value, and that those who may use it will give the author the benefit of any suggestions.

It may be well to direct attention here to the fact, which is much to be regretted, that in bringing together for the first time in this form the information which we possess on the

[1] Flügge, Koch, Wolffhügel, Parkes, Sternberg, Behring, Gärtner and Plagge, Geppert, Cronberg, Loeffler, Pfuhl, Fränkel, Lusk, Fagge, Osler, Welch, Halsted, Abbott, Ghriskey and Robb, *et al.*

subject of disinfection in its application to various infectious diseases, we are confronted by many problems which in the present state of our knowledge it is impossible to solve. For this reason, in those instances in which it is not possible to give definite directions, recourse must be had to general principles of disinfection, such as are laid down in the introduction.

The writer is indebted to Prof. William H. Welch and various other members of The Johns Hopkins Hospital Staff for valuable suggestions.

G. H. F. N.

BALTIMORE, *May*, 1892.

HYGIENIC MEASURES IN RELATION TO INFECTIOUS DISEASES.

INTRODUCTION.

A RATIONALLY conducted system of disinfection combined in certain cases with isolation is one of the most powerful means we have of combating infectious disease. Disinfection, to be rational, must be conducted upon principles based on a knowledge of how the disease is spread, and the peculiarities of the specific infectious agent. In certain diseases, such as smallpox, scarlatina, and measles, we as yet do not know the pathogenic organism which produces the disease, but we know from experience that these diseases can be limited if care is exercised, and the more accurate knowledge utilized, which we have

gathered from the study of certain known disease agents (pathogenic bacteria) and their behavior towards disinfectants.

As these tables may fall into the hands of persons not especially acquainted with the subject, it may not be out of place to make the following observations: *By the term disinfection is meant the absolute destruction of infectious material*, and this is not accomplished by other agents than disinfectants, which must not be confounded with antiseptics and deodorants. *A disinfectant* kills the disease agent or putrefactive organism, and necessarily has some of the qualities of an antiseptic and deodorant. (Many preparations sold as disinfectants are nothing of the kind, but may belong to the following classes.) *An antiseptic* arrests putrefaction or fermentation, but does not kill the micro-organisms, whilst *a deodorant* is used to destroy bad odors from cesspools, stables, discharges, etc. We have

in copperas (sulphate of iron) an excellent antiseptic and deodorant, which can unquestionably be of great service ; for example, in epidemics, where a larger amount of decomposing matter requires treatment than it is practicable to disinfect. It is of the greatest importance that these various agents should not be confounded.

Agents Used in Disinfection.

We can disinfect by means of fire, dry heat, moist heat (applied as steam or boiling water), or by various chemical agents, and, besides this, we can combine the action of disinfectants with the mechanical removal of infectious material, by means of brushes, sponges, cloths, etc. We will now consider the various agents above named.

DISINFECTION BY MEANS OF FIRE.

The simplest and most effectual means of destroying infectious material is by burning

it. This method of destruction being only applicable to worthless articles, has but a limited application as far as contaminated objects are concerned. On the other hand, sputa (especially tuberculous sputa on rags or paper, etc.), fæces (mixed with saw-dust), and wound dressings, etc., soiled with discharges, can be very readily and satisfactorily disposed of through the agency of fire.

DISINFECTION BY MEANS OF DRY HEAT.

Disinfection by means of dry heat has but a limited application. Articles to be disinfected must be exposed longer to the action of dry than to that of moist heat, and in consequence many animal and vegetable fabrics are injured. Dry heat penetrates so slowly that even after an exposure of three to four hours at 140° C. [284° F.] (Koch and Wolffhügel), comparatively small bundles of clothing, etc., are not thoroughly penetrated by the heat. Vegeta-

tive forms of bacteria are killed by dry heat at a temperature of 100° C. (212° F.), usually inside of one hour and a half, whilst spores, as a rule, are only destroyed by a temperature of 140° C. (284° F.), maintained for three hours. If bedding, clothing, etc., are exposed to this latter temperature with any degree of frequency, for example, in hospitals, the fabrics are rendered much less durable. It has been shown that woollen fabrics change color after two hours at 105° C. [220° F.] (De Chaumont); that cotton and linen are affected after two hours at 125° C. [257° F.] (Vallin). It is difficult to control the temperature when dry heat is used, unless it be derived from compressed steam acting through iron pipes, etc. Vermin are destroyed completely after an exposure of but a few minutes to dry heat at a temperature of 105° C (220° F.), and in less than an hour at that temperature they are quite brittle and fall to pieces (Lake). Objects which

have been exposed to dry heat should be allowed to regain their hygrometric water (so as to insure against loss of substance) before being beaten or brushed (Vallin). Dry heat is useful in connection with steam disinfection, as will presently appear.

DISINFECTION BY STEAM AND BOILING WATER.

By means of steam at 100° C. (212° F.) and boiling water, we are able to thoroughly disinfect a number of articles which otherwise would be awkward to manage. *We are dealing here with the most useful and reliable agent we know*, as, on the one hand, it cannot be neutralized, as chemical disinfectants frequently are, and, on the other, the most delicate fabrics can without injury be sterilized by means of steam, provided certain precautions are taken.

Disinfection by Steam. For this purpose a variety of steam disinfectors have been devised. The simplest, which might be of

service in an emergency, is suggested by Flügge ; that is, one made of a cask with one end perforated and the other knocked out, placed with the perforated end uppermost over a vessel of boiling water. The objects to be sterilized or disinfected can be placed on a kind of framework within the barrel, and the escape of steam from around the base of the latter prevented, to a large extent, by wrapping cloths about it. Such a home-made steam disinfector could be used several times, but, of course, would not be durable. The same in principle, but provided with a conical top to prevent the water of condensation from falling on the contained objects, are the ordinary steam sterilizers (made of iron or tinned copper) employed in our bacteriological laboratories. An improvement on these, the "Arnold steam sterilizer,"[1] is useful for the

[1] This most excellent and inexpensive apparatus is manufactured by Wilmot Castle, & Co., Rochester, N. Y. It is made either of heavy

sterilization of small objects, bandages, instruments, etc. When, however, we come to consider what a variety of objects, small and large, it is necessary to disinfect in infectious diseases, we realize the necessity of larger steam sterilizers, and their equipment with a number of arrangements to increase their convenience. We will presently see what objects should and should not be disinfected by steam.

Hospitals and public institutions for disinfection should be provided with capacious steam disinfectors. A number of these have been suggested or patented, but they are all based on the same principle. The best form is tubular, either circular or oval on cross-section, passing through a brick wall separating two rooms. The disinfector has two doors, one

tin with copper bottom, or entirely of copper; the former, of course, being considerably cheaper. The sterilizer can be heated over an ordinary stove, or by means of a gas, alcohol, or kerosene flame. The largest size is 11¼ inches in diameter, and 12½ inches in height.

opening into each room, the infected objects being introduced by the one and removed by the other. The walls of the tube are double, so that steam, superheated if necessary, can be admitted into the steam-jacket thus formed, and heat the objects within the tube without steam being admitted into the inner chamber. By this arrangement one can apply dry or moist heat to the objects inside. It is desirable to first apply the heat (dry) through the jacket until the objects inside reach the temperature of 100° C. (212° F.), as this prevents the steam, which is then let into the chamber, from condensing on the contained objects. This is very important. By means of properly arranged tenting, or thin metal plates arranged on the inside of the disinfector somewhat like shingles on a roof, but with large spaces between them, any water which may condense at the top of the sterilizer is prevented from dripping on the objects, and runs down with-

out injuring them to the floor of the chamber. The steam disinfector is covered on the outside by woodwork and asbestos to prevent loss of heat. By means of such a steam disinfector as this we are also able to utilize steam under pressure, both in the steam-jacket and inner chamber, thus increasing the rapidity of the process. To be properly conducted, two employees should have charge of the disinfector, and two easily cleaned oil-painted carts should be used, the one for the transportation of the infected, the other for disinfected articles. Such carts can be painted of different colors, so as to be easily recognized.

It is best to have a separate building of small size devoted solely to this purpose, and consisting of two rooms, each with separate entrances, one for the handling of infected, the other for disinfected articles, and a third, if necessary, for an engine-room. The man in charge of the objects to be disinfected

should be provided with a skull-cap, overalls, and blouse of canvas or linen, and rubber boots, the same to be disinfected at short intervals. Before removing the outer clothes he has worn whilst handling infectious objects he should wipe them off with a sponge moistened with carbolic acid solution, and after removing them disinfect the hands and face.

Articles such as clothes, blankets, etc., should be hung up in the steam disinfector, not put in rolled up, and towels and mattresses (the latter ripped open in certain cases) so arranged as to leave space between the objects, so as not to prevent the heat or steam from penetrating. In some steam disinfectors, proper racks and wire baskets are provided in which to place the things to be disinfected.

The length of time articles should be exposed to the action of steam. The time required for the disinfection of various articles by means of

steam differs according to their bulk, the larger the object the longer it takes steam to penetrate it. The time is calculated from the moment the air has been expelled[1] from the chamber (this is most rapidly accomplished when the steam enters from above and drives the air out below), and an electric pyrometer or thermometer informs us that the temperature has reached 100° C. (212° F.) or more, depending upon whether we use steam under pressure or not. If the objects are bulky, we place the thermometer within them, so as to know when the heat has penetrated. We can feel sure of small objects being disinfected in half an hour at 100° C. (212° F.), whilst more bulky objects should be exposed one to two hours. When a temperature of 110° to 120° C. (230° to 248° F.) (steam under pressure) is used, five to ten minutes will do for small

[1] Gruber's experiments showed that the presence of air in a steam sterilizer prevents the effective action of steam.

objects, and fifteen to thirty minutes for large.[1]

Disinfection by steam is applicable to clothes, linen, blankets, towels, carpets, curtains, and a variety of delicate fabrics, mattresses and pillows (ripped open if bulky), letters, etc. *Disinfection by steam is not applicable to* linen soiled by blood, pus or fæces, as the stain becomes fixed. Flügge advises placing such objects (which should be contained in bags) twenty-four hours in a disinfectant solution (sublimate and salt), and then wash them off with a stream of water before sending them to be washed. Steam cannot be used, moreover, for the disinfection of objects made of leather or rubber, hair-brushes, combs, etc. These should be disinfected by washing or soaking in carbolic solution, and afterwards be well washed in soap and water.

[1] Without doubt pathogenic organisms are often killed by shorter exposures than those here given, but it has been deemed advisable to err on the safe side.

Disinfection by boiling. The articles to be cleansed[1] should be boiled or disinfected before being sent to the laundry. Boiling for fifteen to thirty minutes will certainly kill all infectious agents. If the articles are dirty, or soiled by fatty or slimy matter, sputa, etc., two per cent. of sal soda (commercial sodic carbonate) should be added to the water in which they are boiled.

CHEMICAL DISINFECTION.

Certain matters to be remembered in connection therewith. It must be remembered that a definite quantity of disinfectant is needed, as it becomes exhausted in action. In other words, the disinfectant must act in a certain concentration upon the infectious material, and must penetrate the latter. Depending upon each case, we must allow the disinfectant to act a

[1] The ordinary treatment to which soiled linen and clothes are subjected in the laundry (one half hour's boiling) would be quite sufficient for their disinfection were it not for the fact that the process of boiling is preceded by the processes of sorting, soaking, and rinsing in cold water (Flügge).

longer or shorter time. The higher the temperature, the more markedly is the power of a disinfectant increased. The germicidal power of a disinfectant varies with each organism, depending in certain cases upon whether it is present in the spore (resistant) or vegetative (less resistant) stage, and the activity of a disinfectant varies also with the conditions under which the disease agent is encountered. In this way, dryness of the object to be disinfected (for example, in the case of tuberculous sputa) will not allow the disinfectant to penetrate, or steam to act as promptly. Again, much organic matter will neutralize the action of many disinfectants.

What is desirable in disinfectants in practice. A disinfectant, to be applicable in practice, must not only stand the severe test of the laboratory, made with a view to its effectiveness under conditions similar to those normally found, but also it must be inexpensive and not dangerous to handle. Further, it

should neither become easily altered in its chemical composition, have a bad, strong or lingering odor, nor injure articles to which it is applied. It is not essential that the disinfectant shall fulfil the severe test made on highly resistant bacterial spores if we can assure ourselves of the fact that the infectious agent is killed by a less powerful germicide. This matter can only be determined by exact experiments. With a view to their application in practice, only those disinfectants which answer the requirements above stated will be found in these tables.

Carbolic acid has the advantage over corrosive sublimate in that it is not so readily decomposed, does not attack instruments, and has a characteristic, not disagreeable odor, which makes it safer for general use. It is used in the concentrations of three and five per cent.

Crude carbolic acid, to which is added an

equal volume of concentrated sulphuric acid (Laplace, Fraenkel), the undissolved parts of oily consistency being removed by filtration, is most effective, more so than pure carbolic acid for the disinfection of excreta, etc. (N.B.—To be kept artificially cool when being mixed.)

Corrosive sublimate (solutions 1 to 500, 1 to 1,000, 1 to 2,000) is precipitated by albuminous substances, and counteracted in proportion to the amount of the latter with which it comes in contact. The precipitated albuminate of mercury is re-dissolved in an excess of albuminous fluid and acts as a germicide when not prevented from penetrating, which it is, however, in practice; for example, by the surface coagulation which takes place on masses of organic matter such as occur in fæces and sputum. Sodium and potassium chloride added in the proportion of five to one to the sublimate in solution prevents the

coagulation above mentioned, as also the action of light from producing alterations in the sublimate.

As an application to wounded surfaces, though very frequently employed, it cannot but be looked upon as practically useless and directly injurious: useless, as the concentration in which it ought to act is lessened by contact with albuminous substances; injurious, as it counteracts the natural germicidal power of the blood, and creates a greater tendency to wound-infection through the formation of a layer of necrotic cells wherever it comes in contact with living tissue, thus lessening the resistance of the part. (Welch.)

Permanganate of potash combined with oxalic acid. Solutions of permanganate of potash and oxalic acid used warm, as described below in connection with surgical disinfection, have given the best results in hand disinfection (p. 97).

Milk of lime; applied as whitewash to walls. The value of this old method of purifying the walls of apartments after infectious diseases has been demonstrated by Jaeger's experiments, where those organisms were chosen as tests which are most likely to be encountered in the disinfection of stables (including *B. anthracis*, the glanders bacillus and the *Staphylococcus pyogenes aureus*), the bacillus tuberculosis being the only one not affected inside of twenty-four hours by a coat of whitewash applied over the surface on which it had been placed.

Applied in the disinfection of excreta. In milk of lime we possess the most valuable agent for the disinfection of typhoid and cholera stools. This agent is prepared as follows: to unslacked lime, placed in a stone jar or wooden trough, as much water as it will absorb is carefully added. The slacked lime is stirred up with four parts of water to form the milk of lime, and this is mixed intimately with

the discharges until the mixture gives a strong alkaline reaction (tested by litmus paper). Owing to the varying age and frequent impurity of lime, it is better to trust to the litmus test (Pfuhl) than to add a certain proportion of milk of lime to the discharges. It does not do to add unslacked lime to discharges, as the pieces of lime are only slowly affected, and in consequence the action of the lime is tardy and weak. We cannot afford the delay, and it should only be used when an opportunity for slacking lime is not immediately at hand.

Chloride of lime to be effective must contain twenty-five per cent. of available chlorine. Its cost is small, six ounces to the gallon of water representing the standard solution recommended by Sternberg.

Sulphur. Twenty grammes are to be burnt to the cubic metre of room space.[1] The sulphur is moistened with alcohol before

[1] Three pounds to one thousand cubic feet recommended by the Committee on Disinfectants, A. P. H. A., 1888.

ignition, and all the apertures leading out of the room closed. By the burning of sulphur, sulphurous acid is evolved (H_2SO_3), which attacks organic matter on account of its affinity for oxygen, combined with which it forms sulphuric acid (H_2SO_4), and to the latter is really due the greater part of the destructive effect. It has been experimentally shown (Wolffhügel and Koch) that only the surface of exposed articles is affected, and that it is practically impossible to attain a proper degree of concentration. The burning of sulphur in the presence of moisture is effectual, but fabrics are destroyed thereby, and metal surfaces attacked. Though sulphur, as generally employed, has not stood the test in relation to pathogenic bacteria, there is some evidence that it may affect other disease agents of a more susceptible nature. On account of the heat evolved by the burning sulphur, the vessel containing the latter should be placed in a basin or vessel containing water.

The fact that a disinfectant must act in a certain concentration and penetrate to be effective demonstrates the utter absurdity of ozone-lamps, or the dropping a little carbolic acid solution into privies, etc., as also the use of this agent when placed in dishes about the room, or when used to moisten suspended cloths, or as a spray intended to purify the atmosphere. Regarded in this light, the burning of sulphur, as generally done, must frequently be useless.

THE MECHANICAL REMOVAL OF THE DUST OR INFECTIOUS AGENT FROM WALLS, FURNITURE, ETC., BY MEANS OF GLUTINOUS BROWN BREAD, BRUSHES, SPONGES, SCRAPERS, MOIST CLOTHS, ETC., IN CONJUNCTION WITH DISINFECTION BY MEANS OF HEAT OR CHEMICAL AGENTS.

The dust which has settled on various objects in the sick-room is to be removed

daily by means of a cloth moistened with bichloride (1 to 1,000). Dusting as it is usually done in private houses simply scatters the dust from one place that it may settle in another. Sponges can also be used for the removal of dust if they are frequently wrung out in a disinfecting solution; it has been experimentally demonstrated that sponges are most efficient for this purpose. The use of scrubbers, etc., see p. 47.

Glutinous brown bread for the removal of the pathogenic organisms from the walls and surfaces of polished furniture, etc., was recommended by von Esmarch, in 1887. Experimentally it gave the best results—that is, it removed the organisms very well from various surfaces over which it was rubbed, the micro-organisms being enclosed in or sticking to the little pellets of bread that are formed in the process of rubbing. Bread has the advantage of not being dangerous to the persons

employed, etc., or injurious to papered or painted walls. The directions are, that the walls be rubbed for at least the height of a man, and the crumbs which fall to the floor burnt. The success of this method depends on the conscientiousness of those engaged in the disinfection, and it has also other objections. The bread is not inexpensive; it must not be too dry nor too moist; small particles adhere to the wall, and may subsequently fall to the floor, be trodden on, and be converted into dust, and the disease agent thus liberated again. Bread is certainly not applicable to walls where crevices and cracks occur, or to others than such as have a smooth surface. See further p. 47.

MEASURES IN WHICH FALSE CONFIDENCE IS FREQUENTLY PLACED.

Ventilation. It has for a long time been considered probable that the ventilation of

the sick-room diluted any infectious agent floating in the air, but nothing short of a good draught will accomplish this, according to the experiments of Stern, which, moreover, show that strong currents of air would have scarcely any effect in reducing the number of organisms once they have settled on the floor or objects in the room.

Sunning, beating, and airing of infected articles. Sunlight has been shown, experimentally, to kill the resistant spores of the anthrax bacillus, as also the bacillus tuberculosis, in a few hours. However, this agent would not do in practice, as it only acts on the immediate surface of infected objects. Beating and airing are not to be relied on for the removal of the infectious agent, as the latter adheres too closely to various fabrics, especially flannel, etc., to be removed by any mechanical process (Stern); and even though a vacant lot may be chosen for beating and brushing of

the infected articles, the infection may be spread thereby, and those engaged in the beating are greatly exposed. See further p. 36.

Commercial disinfectants are, as a rule, unreliable, having usually only the qualities of antiseptics or deodorants, besides being, as a rule, expensive.

PRACTICAL DIRECTIONS

PRELIMINARY REMARKS.

AN infectious disease is one which is caused by the invasion and multiplication within the body of pathogenic organisms derived from various sources.

In the following pages we shall consider only such infectious diseases as are due to pathogenic *micro*-organisms, and particularly those to which a system of disinfection should be applied. We shall describe as contagious such infectious diseases as are directly or indirectly communicable from one person to another.

The extent to which disinfection should be carried out varies in different infectious diseases, and it seems advisable from this point of view to classify those where disinfection is

usually practised, even though it be provisionally in accordance with our knowledge of how disease spreads, and the peculiarities of the specific infectious agent. The following table represents such a provisional classification, the diseases being grouped in three columns, according to the degree of infectiousness which characterizes them. Several diseases, about which insufficient knowledge exists, have been omitted from the table.

At first sight tuberculosis may appear misplaced, but by referring to page 87, where we speak of this disease and how it is spread, we see the necessity of careful and complete disinfection, especially in the houses of the poorer classes, where the habit of careless expectoration on carpets and floors is particularly prevalent. The slow development of the disease, and the fact that a large number of persons are apparently immune, disguises greatly the degree of infectiousness which

INFECTIOUS IN THE 1ST DEGREE.			2D DEGREE.		3D DEGREE.		
The infectious agent can float in the air, and in consequence gain access to individuals in a variety of ways.			The infectious agent carried doubtless in the food and drink.	The infectious agent may float in the air in badly infected districts, but is usually derived directly from diseased carcasses, or through insects, a cut or abrasion being necessary.	Contact with comparatively fresh secretions required (in 1, contact with abraded surfaces, in 2, with mucous membranes).	Wounds penetrating the subcutaneous tissue required for the development of the infectious agent.	Bites of animals in a rabid state.
No previous lesion apparently required (though wounds predispose, and the disease is reproducible by inoculation).	Lesion doubtless required.						
Acute exanthemata. Diphtheria. Glanders. Tuberculosis (see section preceding this table).	Erysipelas. Puerperal fever. Septicæmia.	Yellow fever.	Cholera. Typhoid. Dysentery.	Anthrax.	1. Syphilis. 2. Gonorrhœa.	Tetanus. Malignant œdema.	Hydrophobia.
Danger from everything about the patient.		Vomit dangerous. (See further p. 93.)	Danger from dejections and anything to which they gain access.	Danger from anything (fæces, urine, etc.) containing or apt to contain blood where infection is general, as in cattle and sheep, and occasionally in man, and when local, the secretions of the infected parts.	Danger from secretions, either directly or indirectly.	Wound secretions dangerous.	

tuberculosis possesses, and, though susceptible individuals may be in the minority (we cannot say in advance who are and who are not susceptible), it is our duty to protect them by every means in our power.

As far as practicable we should deal with the infectious agents at their point of origin and under all circumstances act promptly. By proceeding in this way we have the best chances of limiting the disease. In the acute exanthemata we prevent the diffusion of the infectious agent by means of applications of fatty substances to the skin, and by combining a disinfectant with the application we perhaps lessen its virulence. Gargles and washes of dilute disinfectants have the same effect. We should disinfect promptly, as we know in certain cases that the infectious agent is capable of multiplying outside the body, and in consequence the longer we wait the greater may be the amount of infectious agent we have to

deal with. If we wait too long insects may have an opportunity of gaining access to vessels containing excreta, etc., and act as carriers, or through desiccation an opportunity is given the infectious agent to become scattered about as dust. We know that moist surfaces will not permit the diffusion of infectious agents. Lastly, it is desirable always to use a chemical disinfectant in a sufficiently concentrated form, or heat for a long enough period, to exclude all possibility of the disinfection not being complete.

PRECAUTIONS TO BE OBSERVED BY PHYSICIANS AND THOSE IN ATTENDANCE ON THE SICK.

The physician should watch his movements in the sick-room, avoiding, as much as possible, all contact with objects about the patient, as well as the patient himself. He should avoid sitting on the bed, and should not wear clothes to which dust or infectious matter can

readily adhere; in fact, it is advisable, and in some hospitals customary, for him to draw on a long linen duster before entering the sick-room. Such dusters should be disinfected by boiling or steam sterilization, or be sponged off with carbolic acid solution at stated intervals, and it would be well to keep several hanging on pegs outside the hospital wards for infectious diseases. After handling the patient or touching anything about him, the physician should disinfect his hands in a basin of three-per-cent. carbolic solution, which, together with a nail-brush, should be kept constantly on hand in the sick-room, or an ante-chamber leading thereto.[1] Clinical thermometers and all instruments should also be disinfected in carbolic acid immediately after being used.

The nurse or attendant on the patient should observe the same precautions as the

[1] Under certain circumstances, especially when handling infected dressings, the use of rubber gloves, which are kept soaking in a disinfectant solution, is to be recommended.

physician. Nurses presumably immunified by having had the particular disease themselves are to be preferred. They should be isolated with the patient, and be clothed in linen or some other material which can be washed and starched and will not convey the infectious agent. The nurse's clothing should be washed with as many precautions as that of the patient. Other measures than those here mentioned will be found on p. 73, under puerperal fever, etc.

INFECTIOUS DISEASES IN PRIVATE DWELLINGS.

It is almost impossible to successfully isolate individuals suffering from infectious diseases in private houses, and to carry out a proper system of disinfection under conditions where ignorance, sloth, or poverty exist. Even in the houses of the better classes it is generally impracticable to do what ought to be done on account of indifference to consequences, or

false ideas of economy. Nevertheless it is necessary to do all that can be done in each case, and this must be determined by the conscientious physician. When practicable a room or apartments at the top of the house should be chosen in which to place the invalid. All superfluous objects (curtains, carpets, hangings, pictures, ornaments, etc.), which are liable to catch the dust should be removed, only what is absolutely necessary for the patient's comfort being left in the room. It is desirable that good ventilation be maintained by means of an open fireplace, or other arrangement by which the air of the room can be caused to pass directly out into the open air through the chimney or window. A sheet kept constantly moistened with carbolic acid and glycerin, or with chloride of lime solution, can be tacked outside of the door which opens into the sick-room, making it necessary to push it to one side in going in and out of the

room, thus making the isolation more perfect. As moisture, darkness, and a low temperature permit the infectious agent to retain its virulence longest, it is advisable to guard against infected clothing, soiled linen, etc., being thrown into dark corners, cellars, or trunks. Damp, dark houses should be heated and ventilated as well as possible.

REGARDING THE INMATES OF A HOUSE WHEREIN EXISTS AN INFECTIOUS DISEASE.

All children belonging to a family where an infectious disease has occurred should be prevented from attending school for a longer or shorter period, as will be seen on reference to pages 60, 72, etc. Jacobi wisely suggests that provision should be made for the removal of healthy children from infected houses to sanitaria, so as to guard against their contracting the disease.

CARE OF THE SICK-ROOM.

No beating or brushing of clothes, or dusting should be done in the sick-room, but all dust should be removed daily from places where it may have lodged, by means of a cloth moistened with disinfectant (see p. 47). In this way, window-sills, furniture, and floor[1] should be kept perfectly clean. Visitors, as far as possible, should be excluded, and the isolation of the patient continued until convalescence is well established, or death has occurred. The presence of insects in the sick-room should be guarded against as much as possible, in view of the fact that they may act as carriers of disease. No foods should be allowed to stand about uncovered, or for any length of time in the room, as in certain cases pathogenic organ-

[1] Though wet tea-leaves and saw-dust are excellent for the removal of dust from floors in the ordinary routine of domestic life, they cannot be recommended in the sick-room.

isms may gain access to them and multiply therein. Nothing should be removed from the room without being first disinfected, or wrapped in a cloth moistened with disinfectant, in which it is carried to a proper spot to be disinfected. The slops (the water used for washing the patient, linen, etc.) should always be disinfected.

The floors of a sick-room or hospital ward should be rendered impervious. In the Johns Hopkins Hospital they have hitherto been treated as follows: Eight ounces of paraffin are dissolved in one gallon of turpentine, and the solution applied to the floors with a mop. The floors are then rubbed over with a stiff-haired brush loaded with lead. Such floors can be kept very clean from dust and can be readily disinfected. In other hospitals melted paraffin has been applied to the floors to render them impervious.

THE DISPOSAL OF INFECTED CLOTHING, BEDDING, ETC., IN HOSPITALS AND PRIVATE DWELLINGS.

Unless soiled with discharges, infected clothing, towels, bedding, linen, blankets, etc., are best rendered harmless by steam sterilization or boiling. When about to be removed from the room, such articles should be received at the bedside into a covered vessel containing, if necessary, some carbolic solution, or should be folded up in a sheet moistened with disinfectant (sublimate 1 to 2,000). In this way the infectious agent will be confined whilst the objects are being transferred to sacks in which they are sent to the disinfector. A convenient form of chute for infected clothing intended for use in hospitals, has, at the writer's suggestion, been put into operation in the Johns Hopkins Hospital.[1] The chute terminates in a stout canvas bag, in which the objects should be directly transferred to the

[1] See *Johns Hopkins Hospital Bulletin* for April, 1892.

disinfector on a cart of simple construction and oil-painted. Two carts should be used, differently numbered or painted, the one for the infected clothing going to, and the other for the disinfected clothing coming away from, the disinfector. The advisability of a steam disinfector passing through the wall between two rooms, the one for the reception of the infected, the other for the delivery of the disinfected, clothing, has already been considered. Infected articles in private houses should be disinfected on the spot, or after being properly enveloped carried to some public institution, which will attend to their proper disinfection. Such objects should on no account be sent to cleaning establishments or laundries. No time should be lost in having the clothing, etc., disinfected, as if laid aside they may be forgotten and, the proper conditions for the maintenance of the infectious agent existing, an oversight may lead to grave consequences.

DISINFECTION OF EXCRETA, WATER-CLOSETS, CESSPOOLS, ETC.

Excreta (Sputa, Urine, and Fæces).

Sputa are best disinfected by steam sterilization, together with the sputum cups. The addition of fifteen grammes of sal-soda to the litre of water materially aids the process of cleaning. A small disinfector with a suitable rack for sputum-cups has been suggested for this purpose in hospitals (Kirchner), and should certainly be put into general use. The disinfection should take one half hour—that is to say, the sputum should be exposed to the action of steam for one half hour at 100° C. (212° F.).

Urine and fæces are best treated together by means of milk of lime, prepared as given on p. 19, and added in sufficient quantity, so that after being well mixed with the stools, a strong alkaline reaction is obtained, as tested

by litmus paper (Pfuhl). Allow the vessel to stand one hour, or if it be desired sooner, empty it after not less than fifteen minutes, and rinse it out well with fresh milk of lime.

A quart of chloride of lime solution (four ounces to the gallon) added to each typhoid stool is recommended by Sternberg. The solution must be fresh and contain twenty-five per cent. of available chlorine.

Carbolic acid (unless in combination with sulphuric, as given on page 16) and corrosive sublimate are not suitable for the disinfection of stools. The strong mineral acids can be used in pits where the discharges have been thrown. Discharges can also be disposed of by burning after admixture with sawdust, etc.

Water-closets are best disinfected by chloride of lime solution, or five per cent. carbolic acid; *cesspools* by chloride of lime or preferably milk of lime added in the manner above stated.

PRECAUTIONS WHICH SHOULD BE TAKEN IN TRANSFERRING A PATIENT TO A HOSPITAL.

The most criminal negligence exists in this respect. The transfer of a patient suffering from an infectious disease to a hospital should be combined with proper disinfection of the apartments he has occupied. He should be cared for by a reliable person sent by the hospital, and the patient, properly covered with sheets moistened with dilute disinfectant, be transported to a suitable vehicle and by this means brought to the hospital. Public vehicles of any sort should not be used. The vehicle in which the patient is transferred to the hospital should be properly constructed for the transfer of the sick on a cot, and be oil-painted on the inside, so as to facilitate disinfection after each journey. On arrival at the hospital and before admission to the wards the patient should, under all conditions, when practicable, receive a bath, and the clothing in which he has been admitted

should always with proper precautions be disinfected. A special department for the reception of patients should exist in every hospital provided with rooms for undressing, bath-rooms, etc.

Public institutions for disinfection should exist in every community, being properly officered and having competent intelligent men to do the work. The disinfection of dwellings as carried out by our State Health Departments in different parts of this country is often utterly absurd and inadequate. A regular service of intelligent trained men is what is necessary. Steam disinfectors on wheels can be employed in certain districts; otherwise one such as is described on page 7 will answer all purposes.

THE IMMEDIATE CARE OF THE PATIENT'S PERSON IN THE SICK-ROOM.

Everything that has had an opportunity of directly or indirectly coming in contact with the

infectious agent should be treated as infectious matter.

The bedstead should be of iron with a spring mattress, supporting a mattress that is not too soft, and the latter, as also the pillows, in cases where discharges occur should be protected with rubber sheets. Tarnier has recommended tarred paper to protect the mattress under certain circumstances. The bed and bed linen should be renewed as soon as soiled. The person of the patient should, of course, be kept as clean as possible. In the exanthemata the application of fatty substances to the skin will prevent, to a large extent, the diffusion of epidermal scales. When the fæcal discharges are soft or occur in bed, toilet paper followed by compress-cloth or clean soft rags moistened with dilute disinfectant (carbolic acid three per cent.) should be used to clean the nates, and these rags disinfected together with the contents of

the bedpan or other receptacle. Clean rags should also be used for wiping discharges from the nose or mouth, and are best gotten rid of by burning. Wound dressings and bandages can be disposed of in a like manner. The eating utensils used by the patient should be kept for his use alone, and be boiled in water containing sal-soda for fifteen minutes, and afterwards be rinsed in pure water. All food and drink returning from the sick-room should not be touched by others. Books or toys or other objects much used by the patient should be of little value and burnt when the time for general disinfection has arrived.

Convalescence.—In the succeeding pages will be found directions concerning the precautions which should be taken during the period of convalescence. Flügge recommends that before the patient leaves the sick-room, when convalescence is well established, he should take a bath, then wash his hands, forearms,

face, and hair with sublimate solution, and, after having put on clean clothes and left the room, remove the sublimate.

The Corpse.—Immediately after death the body should be enveloped in a sheet moistened with five per cent. carbolic acid, or, as recommended by Sternberg, with chloride of lime solution (six ounces to the gallon of water).

THE DISINFECTION OF A ROOM IN WHICH AN INFECTIOUS DISEASE HAS EXISTED.

The room having been abandoned, the door should be locked and no one permitted to enter for twelve to twenty-four hours, during which time the particles of dust and any infectious agent suspended in the atmosphere are given time to settle. The liberation of steam in the room somewhat hastens the process. The persons engaged in the disinfection of the room should wear clothes such as are described on page 11, in addition to which Flügge suggests the use of sponge respirators

They should be provided with sheets and bags of various sizes moistened with sublimate solution, together with metal buckets, sponges, scrubbing-brushes, mops, coarse towels, etc., in a galvanized box, together with plenty of disinfectant solution, soap, sal-soda, and hot-water.

On entering the room the pieces of furniture are covered with the sheets and various articles are placed in the bags. The floor, window-sills, and all surfaces on which dust may have lodged should now be mopped up, or wiped with coarse towels moistened with hot disinfectant, and wrung out at frequent intervals in a bucket containing the solution (5 per cent. of carbolic acid or 1 to 1,000 sublimate). Valueless articles should, if practicable, be burnt in the room.

The walls of the room can now be sponged off with disinfectant, or be rubbed down with glutinous brown bread, or finally, after being dis-

infected or scraped, be whitewashed. If bread is used the crumbs that fall can be caught, to a large extent, on newspapers placed on the floor, and these, together with the crumbs, burnt. One has to guard, as much as possible, against particles of bread adhering to the walls, and, as an extra precaution, it would for this reason be well to wipe the walls, after the first application of bread, with a sponge dampened with the disinfectant, and after the walls had dried use fresh bread a second time. The cleaning of the walls to a height of six feet is usually recommended. The writer believes it would be safer to disinfect the whole surface of the walls. Rooms with papered walls should not be repapered without being disinfected. The furniture and objects which have been placed in the moistened sheets and bags can now be removed from their wrappings and disinfected.

The furniture is brought piece by piece to

the centre of the room and the sheet removed. Upholstered articles should be wiped off with sublimate solution (1 to 1,000) on a moistened sponge, which should be wrung out frequently in the bucket. The articles should be then put in a place where they can dry rapidly. Polished furniture can be wiped off with a sponge, moistened with the same disinfectant. The floors, bedsteads, chests of drawers, windows, doors, fireplaces, wooden mattress frames, etc., should be scrubbed or wiped off with hot disinfectant solution, followed by plenty of scrubbing with soap, sal-soda (especially when sublimate has been employed), and hot water. In fact, it is best to trust to the thorough use of this simple agent (hot water combined with soap) than to place confidence in badly applied chemical disinfectants. The means of disinfection which should be applied to clothing, linen, bedding, etc., are considered on page 38. The slops, as already mentioned,

should be disinfected before being thrown into the drains. In the country care should be taken that they do not in any way contaminate the water supply.

THE DISINFECTION OF SHIPS.

Satisfactory disinfection of ships is scarcely possible, but a good deal can be accomplished by observing certain precautions. Vessels plying between ports where infectious diseases, such as cholera or yellow fever, occur should be well ventilated throughout and dispense as much as possible with curtains, woollen and upholstered articles, etc., during the prevalence of the disease. They should be kept scrupulously clean, the closets disinfected, and the bilge pumped out and cleansed at sea before entering the harbor on the return from an infected port. The pumps should always be accessible for this purpose. As far as possible the crews of vessels trading in tropical ports should be acclimatized. In ports infected with yellow fever, vessels should be anchored, when

possible, in the harbor and the crew prohibited from going ashore, especially at night. Vessels should be disinfected by being washed down thoroughly in every accessible place, more particularly in those occupied by the sick, by means of a solution of sublimate or carbolic acid applied in the strength and manner described on page 16. The burning of sulphur followed by the use of soap and hot water has been recommended in addition to the above measures. (*American Public Health Association Report*, 1888.)

THE DISINFECTION OF RAILWAY CARS.

The rules laid down for the disinfection of rooms, etc., apply here also. During the prevalence of cholera, excreta should most certainly not be scattered along the track without being disinfected (page 57).

DISINFECTION OF MAILS AND MERCHANDISE.

This is very rarely necessary, and to carry out proper disinfection is scarcely possible in

practice, on account of the bulk of the objects and the injury to which they are liable. Fumigation by means of sulphur is practised and recommended for this purpose, but as usually applied is useless (page 22), whilst we have no right whatever to rely on "free aëration" as a means of disinfection (page 25). Reliable means for the disinfection of various articles are given elsewhere in this book.

INFORMATION AS TO THE CAUSE AND MODE OF SPREADING OF CERTAIN INFECTIOUS DISEASES AND THE PREVENTIVE MEASURES THAT SHOULD BE RESORTED TO, ISOLATION, DISINFECTION, ETC.

In the following pages those diseases in connection with which it is necessary to carry out a complete system of disinfection are indicated by having their names printed in large type. Immediately beneath the name of each disease will be found that of the parasite which causes it. The letters "O. P." (meaning "obligatory parasite") and "F. P." (meaning "facultative parasite") placed after the name of the pathogenic organism indicate whether the latter is capable of multiplying outside the body (of leading a saprophytic existence under natural conditions), or is only able to live parasitically.

Under three headings will be found the following information :

1. How the infection spreads. How long the infectious material may remain virulent. Its resistance to heat, chemical disinfection, etc. The conditions which favor the development and maintenance of virulence of the infectious agent.

2. Measures which must be taken to prevent the spread of the disease, such as isolation, etc.

3. The disinfection which should be pursued.

The information is sadly incomplete in some cases, owing to our ignorance of the nature of the specific agent which causes the disease, or its mode of attacking the body.

1.—Actinomycosis ("Big-jaw" of Cattle).

CAUSE : ACTINOMYCES OR "RAY-FUNGUS."

Mode of Infection, etc.

As the pus in this affection, and cultures of actinomyces derived therefrom, have been shown to be infectious by inoculations in animals, the pus should be treated as

infectious matter. The specific agent probably enters the system with the food, from the fact that the site of infection is usually, both in man and animals, the mouth or passages leading therefrom.

Preventive Measures and Disinfection.

Pus or anything soiled therewith should be disinfected (page 38).

2.—Anthrax (Malignant Pustule).

CAUSE : BACILLUS ANTHRACIS, F. P.

Mode of Infection, etc.

The disease, which is epidemic amongst cattle and sheep, is most frequently communicated to men engaged in scraping horns, skinning carcasses, or wool-sorting (wool-sorter's disease), the hands, less frequently the face and neck, in short the exposed parts of the body, usually being the seat of inoculations through abrasions and cuts. The bacilli are present in the blood and œdematous fluid of man and animals when the disease is general. When the disease is local ("malignant pustule") as is usually the case in man, the bacilli are present in the secretion from the pustules. The fæces, and bloody urine of sheep and cattle may contaminate the surface

soil and vegetation of pastures. Insects feeding on excreta or cadavers of anthracic animals will spread the disease by bites inflicted on other animals or possibly man. All bandages which have been in contact with the pustules are dangerous. The disease may also occur through eating the smoked flesh of anthracic animals, where, owing to the bacilli having taken on the spore form, they may retain their virulence indefinitely. This form of the disease (internal anthrax) may also be brought about, as it has been experimentally, by the inhalation of spores. The fresh secretions, blood, etc., only contain the bacilli in the vegetative stage, when they are readily killed by carbolic acid or boiling water, though they withstand drying for several days. The bacilli in spilled blood, etc., form very resistant spores, which remain virulent for years in a dry state. They resist five per cent. carbolic acid as long as thirty-seven days, and corrosive sublimate, 1 to 1,000, for twenty-four hours. Moist heat at 100° C. (212° F.) applied for four minutes kills the spores.

Preventive Measures.

Infectious skins should be destroyed and anthracic animals buried in deep pits, their bodies being covered with chloride of lime. Protective inoculations (Pasteur)

have been applied with a view of limiting the disease in animals. Bandages, infected clothing, or dressings soiled by the discharges of malignant pustules should be very carefully handled and disinfected.

Disinfection.

Soiled dressings, bandages, etc., should be burnt; other articles, when practicable, should be boiled or sterilized by steam for at least fifteen minutes.

3.—Cholera.

CAUSE : SPIRILLUM CHOLERÆ ASIATICÆ. F. P.

Mode of Infection, etc.

The infection occurs through the fresh dejections, very exceptionally through the vomit, of cholera patients, conveyed more or less directly in water or food to the digestive tract of another individual. The water supply may be contaminated by discharges, through the washing of soiled linen, or surface drainage. Insects may contaminate food. The food may be also contaminated through the soiled hands of attendants or sick persons. The spirilla will multiply readily if they gain access to milk, bouillon, meat, etc.

If dried the spirilla soon lose their virulence, so that infection probably never occurs through the air becom-

ing a vehicle for the disease agent. Culture experiments show the spirilla to die in two or three hours if dried in a thin layer, whilst in thicker layers they may live for twenty-four hours. At a low temperature combined with incomplete drying the spirilla may remain alive for weeks or months. Freezing has no effect on the organisms. In water at 60° C. they are killed off in ten minutes. They are very sensitive to disinfectants, and die in putrefying fluids in about two weeks. One half per cent. carbolic acid kills them in a few minutes. Acquired immunity is of short duration—that is, it can only be relied on to protect individuals (with very few exceptions) from a second attack during the one epidemic.

Preventive Measures.

What has been said for typhoid fever (page 90) applies to cholera also. The necessity of keeping the sick-room well ventilated, so as to kill the spirilla by the simple process of drying, is apparent. Soiled linen should not be allowed to stay in cool, dark, and damp places, or be transported in a damp state, and should be disinfected and hung up in the sun to dry and air. The fact that washer-women are particularly prone to contract the disease is a direct indication that the handling of soiled linen, etc., is dangerous.

During epidemics the preventive measures referred to in the case of typhoid apply here also. Extra care should be taken about the cooking of the various foods.

Disinfection.

Proceed as in typhoid fever (page 92).

4.—Diphtheria.

CAUSE: BACILLUS DIPHTHERIÆ. O. P.

Mode of Infection, etc.

The infection is spread through the bacilli in the sputa, false membrane, and secretions of the various diseased mucous membranes. The bacilli are probably present at times in the stools. Physicians and nurses are particularly exposed to the danger of the infection when swabbing the throats of patients, through the coughing of mucus and flakes of membrane into their faces. Lesions of the mucous membranes where no susceptibility exists predispose to infection. The diphtheria of pigeons, calves, pigs (not determined in the case of the cat) is not to be feared as a source of human diphtheria, the diseases being due to different specific agents.

As the bacilli resist drying they may be scattered about in the form of dust. In thin layers the bacilli

withstand drying for fourteen days, whilst in pieces of membrane, clothing, particularly when in dark, damp, and cool places, they may retain their virulence for four to seven months. A temperature of 58° C. (136° F.) kills them in ten minutes. They apparently die in a few days in putrefying substances. The bacilli multiply at 18° C. (64° F.), and milk being an excellent medium for their growth, the milk of dairies in a vicinity where the disease prevails may be a carrier of the infection and promote the development of the infectious organism.

Preventive Measures.

Complete isolation of the patient is necessary as long as the slightest trace of the membrane is present, and for some time after it disappears. Children should be kept from attending school at least four weeks after the disease has disappeared. Where the disease prevails, Loeffler maintains the importance of keeping the mouths, noses, and throats of healthy children clean, using for this purpose an aromatic or other wash every three or four hours; sublimate, 1 to 10,000 or 15,000; cyanide of mercury 1 to 10,000; chloroform water, etc. For the patients he recommends a gargle every two to three hours of the nature recommended above, together with a stronger one used at longer intervals; namely, subli-

mate 1 to 1,000 ; three per cent. carbolic acid in thirty per cent. alcohol ; or equal parts turpentine and alcohol containing two per cent. carbolic acid. These washes are intended to prevent the settlement and development of the bacilli on adjacent mucous membranes, and limit the growth of the membrane. Virulent bacilli could not be found after a few days when this treatment was followed, whereas they are to be found usually after three weeks when the ordinary treatment is pursued. Special precautions should be taken when using poisonous solutions in the treatment of children.

Disinfection.

See "Practical Directions," page 27.

5.—Dysentery (Amœbic Dysentery).

CAUSE : AMŒBA DYSENTERIÆ.

Mode of Infection, etc.

The dejections of the patients contain the amœbæ in such enormous quantities, and the latter bears such an unquestionable relation to the disease, that the stools should be treated as infectious material and the possible contamination of the water supply guarded against.

Preventive Measures.

The precautions noted in the case of typhoid fever and cholera as regards the treatment and handling of stools, soiled linen, and the person of the patient, apply here also.

Disinfection.

Disinfection to be pursued as in typhoid fever (page 92).

6.—Erysipelas.

CAUSE: STREPTOCOCCUS ERYSIPELATOS.

Mode of Infection, etc.

Occurs usually as epidemics in hospitals. It is rarely found as an epidemic otherwise. The disease is easily communicated from one person to another. The streptococcus erysipelatos, resisting dryness, can float in the air as dust and reach wounded or abraded surfaces in a variety of ways. It is killed by moist heat at 54° C. (129° F.) in ten minutes (Sternberg).

Preventive Measures.

Prompt isolation of cases of erysipelas in hospitals is necessary, and if the disease continues to appear in the wards empty the latter, thoroughly disinfect them and

all the furniture they contain. The clothing and bedding of the patients should be sterilized before their return to the wards. Physicians and nurses should disinfect themselves, their clothing, etc. Carelessness or some oversight will be found invariably connected with the spread of this disease.

Disinfection.

All dressings, bandages, etc., should be burnt, and other objects disinfected by boiling or chemical disinfectants (see "Practical Directions").

7.—Glanders or Farcy.

CAUSE: BACILLUS MALLEI. O. P.

Mode of Infection, etc.

The disease can be transmitted to man directly from diseased domestic animals [the horse, donkey (sheep, young dogs, and cats are also susceptible experimentally)] through the fresh secretions or excretions of the mucous membranes and skin, which may adhere to various articles about and produce the disease by inoculation through a cut or an abraded surface of the skin or on the mucous membrane. The bacilli lose their virulence in a few days when dried, though they

have been found to resist putrefaction for twenty-four days. They are killed after ten minutes at 55° C. (131° F.). Three to five per cent. carbolic acid or scalding water readily renders them harmless.

Preventive Measures.[1]

Isolation of the patient is imperative. Horses suffering from glanders should be killed and buried in a grave eight feet deep. To facilitate this, cutting off the legs of the animals is advisable. Chloride of lime should be thrown over the body before heaping on the earth. Bridles, bits, pails, and troughs should be disinfected.

Disinfection.

Where glanders has existed in a stable remove everything that is portable, burning as much as is practicable. Loose pieces of boarding, etc., especially the woodwork about the manger, should be destroyed in this way. Wash and clean out the stall thoroughly and then scrape it. Rinse it out with cold water, being sure at the same time to scrape out all cracks in the floor and woodwork with a sharp instrument, following this with the applica-

[1] For particulars in relation to the treatment of diseased horses and stables, the writer is indebted to A. W. Clement, V. S., of Baltimore.

tion of scalding water wherever practicable, and fifty per cent. permanganate of potash solution. Finally, apply whitewash and scatter fresh chloride of lime on the floor.

8.—Gonorrhœa.

CAUSE: MICROCOCCUS GONORRHŒÆ. O. P.

Mode of Infection, etc.

Through fresh secretions coming in contact with mucous membranes of the urethra or conjunctiva. The gonococcus is killed by an exposure to moist heat at 60° C. (140° F.) for ten minutes (Sternberg).

Preventive Measures.

Persons suffering from this disease should be careful that no other person touch clothes, towels, or handkerchiefs soiled by gonorrhœal secretions. They should also guard themselves against gonorrhœal ophthalmia by disinfecting their hands, etc., when the latter have come in contact with the urethral discharge.

Disinfection.

Rags and scraps of linen soiled by secretions should be burnt; towels, etc., boiled or soaked in corrosive sublimate solution (1 : 1,000) to which five parts sodium chloride have been added.

9.—Hydrophobia—Rabies.

CAUSE: UNKNOWN.

Mode of Infection.

Through the bites of rabid animals and their fresh saliva (experimentally produced by inoculation with their brain and spinal cord). The virus loses its pathogenic qualities after an exposure to moist heat at 60° C. (140° F.) for ten minutes. (Sternberg.)

Preventive Measures.

Very effectual laws exist regarding this disease in Germany. No dogs are allowed on the streets during the prevalence of rabies without being muzzled and led. Unmuzzled dogs are promptly killed.

10.—Influenza.

CAUSE: BACILLUS OF INFLUENZA.

Mode of Infection, etc.

Infection doubtless occurs from individual to individual, and more or less indirectly. On account of the large number of organisms in the sputa, Lœffler suggests that these be treated as infectious material.

Preventive Measures.

During epidemics of influenza those persons who are especially liable to succumb (old persons or those suffering from heart disease, etc.) should absent themselves from public assemblages (where they expose themselves to a confined atmosphere contaminated by the presence of the infectious agent) and more or less completely isolate themselves.

Disinfection.

Sputa should be disinfected.

II.—Leprosy.

CAUSE: BACILLUS LEPRÆ. O. P.

Mode of Infection, etc.

That leprosy is contagious is doubted by many. We consider it a reasonable supposition that the contagiousness of the disease is obscured by the fact that the majority of individuals are resistant and that the disease develops very slowly. Where the disease has been ascribed to contagion usually the most intimate sexual relations with diseased individuals have existed.

Preventive Measures.

Isolation of patients in leper hospitals in various parts of the world has reduced the amount of the disease. Inter-marriage of leprous individuals should not be permitted.

Disinfection.

Dressings should be burnt.

12.—Malaria.

CAUSE : PLASMODIUM MALARIÆ.

Mode of Infection, etc.

This disease is not contagious. We do not know how invasion occurs. It is acquired most readily in low, marshy or badly drained regions, where abundant vegetable growth occurs, such conditions being found especially in tropical and sub-tropical regions. The disease in temperate climates prevails most in autumn, especially after hot dry summers, and in the tropics during the rainy season. Facts are on record which point to the wind as a carrier of the poison.

Preventive Measures.

From the fact that infection seems to occur most frequently at night, persons should avoid exposure at that

time. It has been repeatedly shown that persons occupying the upper stories of a house do not acquire the disease as do those living nearer the ground. Trees planted in malarial districts have been considered to have a preventive influence. Where the disease prevails extensively Osler recommends the boiling of drinking water. In highly malarious districts ten grains of quinine should be taken daily ; smaller doses, three to five grains, will otherwise suffice, and Jones recommends the use of this remedy until ten days after exposure. The severity of attacks is moderated when not prevented by the use of this remedy.

13.—Malignant Œdema.

CAUSE : BACILLUS ŒDEMATIS MALIGNI. F. P.

Mode of Infection, etc.

The specific organism is frequently found in the surface soil, especially at times in garden-earth and in putrefying matter. The dust of apartments, hay-lofts, and that derived from rags, also the intestinal contents of animals, have been found to contain them. They are found at times together with the tetanus bacilli, producing infection under the same conditions. Pieces of muscle of an animal dead of the disease have been found to contain virulent bacilli after one year.

Preventive Measures and Disinfection.

Proceed as in tetanus (p. 83).

14.—Measles.

CAUSE: UNKNOWN.

Mode of Infection.

The infection is spread through the products of the diseased skin and mucous membrane, especially the nasal secretions. The infectious agent may remain virulent for six weeks. One attack does not always confer immunity.

Preventive Measures and Disinfection.

This disease is infectious in the first degree (see table, p. 29), and in consequence the precautions laid down under "Practical Directions" apply here in a general way.

15.—Cerebro-Spinal Meningitis.

CAUSE: THE DIPLOCOCCUS PNEUMONIÆ HAS BEEN ISOLATED FROM THE CEREBRO-SPINAL FLUID.

Mode of Infection, etc.

Not directly contagious, probably not transmitted by clothing or excreta; occurs sporadically and as an epidemic (Osler).

Preventive Measures.

Good ventilation and isolation are indicated, from the fact that crowding of individuals in barracks or tenement-houses offers favorable conditions for the development of epidemics of the disease.

16.—Mumps (Epidemic Parotitis).

CAUSE : UNKNOWN.

Mode of Infection, etc.

A contagious, often epidemic, disease most frequently attacking children and adolescents. One attack immunifies. We lack definite knowledge as to the mode of infection.

Preventive Measures.

Isolation.

17.—Pertussis (Whooping-Cough).

CAUSE : UNKNOWN.

Mode of Infection, etc.

A contagious disease, the gravity of which is frequently not sufficiently appreciated by parents. A great deal of neglect exists in this respect.

Preventive Measures.

Children suffering from this disease should be promptly isolated and prevented from attending schools.

18.—Pneumonia.

CAUSE: DIPLOCOCCUS PNEUMONIÆ.

Mode of Infection, etc.

The contagiousness of this disease is unproven, though probable at times (epidemics in barracks, etc.). For the reason that only a limited number of individuals are susceptible, that the organisms vary greatly in virulence, and that a certain number of individuals (15 to 30 per cent.) have the specific organisms of pneumonia normally present in the mouth, in such cases the disease might well arise at any time under favorable conditions and it would not be preventable, but from the fact that the sputa of pneumonic patients contain large quantities of the pneumococcus they should be treated as infectious matter. The pneumococcus withstands drying and remains infectious for two or three months in diffuse light at room-temperature, and consequently could very well be inhaled as dust and reproduce the disease under proper conditions.

Preventive Measures.

In the case of house epidemics, isolation and free ventilation are indicated, as also a thorough cleansing of apartments.

Disinfection.

Disinfect sputa by boiling or burning.

19.—Puerperal Fever.

CAUSE: VARIOUS PYOGENIC BACTERIA (STAPHYLOCOCCI AND STREPTOCOCCI).

Mode of Infection, etc.

Pathogenic micro-organisms are invariably present in this disease. Though auto-infection may occur, in the vast majority of cases the disease is spread through the agency of physicians, midwives, or nurses, especially is this so in epidemics, where the hands, instruments, etc., of those in attendance are not properly disinfected. The pathogenic organisms find a very good opportunity for their multiplication in the presence of the broken-down tissue and the wounds which occur in the genital tract during parturition. As the organisms which produce this disease are capable of resisting desiccation they can be suspended in the form of dust, thus contaminating the

atmosphere of the room or ward. (Regarding the degree of resistance exhibited by the infectious agent see figures in connection with pyogenic bacteria, page 79.)

Preventive Measures.

The first duty of the physician should be to avoid attending cases of labor when fresh from the presence of erysipelas, puerperal fever, scarlatina, or other infectious diseases or septic material. Frequent examination during labor should be avoided. In hospitals women before admission to the obstetrical wards should, if possible, be well bathed and clothed in fresh linen. The external genitalia and surrounding parts should be well washed with soap and water, followed by sublimate 1 to 2,000, with which the vagina should be carefully irrigated both before and after labor. Compresses moistened with dilute disinfectants are also recommended as applications to the external genitalia during the progress of labor.

Patients should be isolated promptly on the first appearance of any suspicious symptoms, and a special nurse put in charge of the case. Physicians should take the precautions regarding the disinfection of instruments, hands, etc., which are noted on page 96. These observations apply also to midwives and nurses. When

the disease prevails in hospital wards take the precautions observed in relation to erysipelas under like conditions.

Disinfection.

As in erysipelas—see above.

20.—Relapsing Fever (Febris Recurrens).

CAUSE : SPIRILLUM OBERMEIERI.

Mode of Infection, etc.

A moderately contagious, at times epidemic, disease, portable (according to Murchison) by fomites. The disease has been reproduced by inoculations in man and monkeys made with the blood of individuals suffering from the disease. The life history of the specific agent is unknown. Neither age nor season have any particular influence. One attack does not protect either in the experimentally or naturally acquired disease. Overcrowding, such as occurs in tenement-houses, and lack of food (hence also called "famine fever" or "hunger pest," etc.) promote the spread of the disease.

Preventive Measures.

Good ventilation and food are directly indicated, as the absence of these promotes the spread of the disease.

The disease is not likely to spread from a single case placed in a well-ventilated apartment. Persons suffering from this disease in tenement-houses should be removed to hospitals, and the population of overcrowded tenements thinned (Osler, Flint, etc.).

21.—Rubella; Rötheln.

CAUSE: UNKNOWN.

Mode of Infection, etc.

Spreads with great rapidity, and often extensive epidemics occur; readily communicated from one individual to another. (The occurrence of either measles or scarlatina in childhood does not afford protection against it.) (Osler.)

Preventive Measures and Disinfection.

See measles, page 70.

22.—Scarlatina.

CAUSE: UNKNOWN.

Mode of Infection, etc.

Scarlatina is spread after the same manner as smallpox. The infectious agent may remain virulent for five

months, and possibly longer at times. Unless an attack has been mild, immunity is usually afforded for a number of years. The contagiousness probably begins with desquamation. According to Henry, scarlatinal virus loses its virulence after being exposed to dry heat at 100° C. (212° F.) for one hour.

Preventive Measures.

The same precautions regarding isolation should be practised as in the case of smallpox. Desquamation lasts from ten to fifteen or twenty days, and may continue at times for weeks. Oiling the skin every day or second day, combined with soaking in hot baths during desquamation, and washing with carbolic soap, are recommended. The feet being very slow to desquamate, the process can be hastened by hot foot-baths with soda, combined with rubbing with pumice-stone. Socks and gloves smeared with ointment (carbolic or salicylic) should be used. Probably when desquamation has lasted four weeks and daily baths have been resorted to in the way above mentioned, the person can be dismissed. Convalescent hospitals for the reception of scarlatinal patients are specially recommended.

Disinfection.

See smallpox, page 78.

23.—Smallpox.

CAUSE : UNKNOWN.

Mode of Infection, etc.

The infection is spread through the products of the diseased skin and mucous membrane (the sputa, nasal secretions, etc.). It is not known whether the contagion occurs prior to the desquamative stage. The disease agents are apparently given off in enormous quantities, and as they withstand drying they may tenaciously adhere to anything about the patient, thus infecting objects and persons around him. The light epidermal scales derived from the patient may float in the air as dust, and doubtless are capable of producing the infection through inhalation. With very few exceptions one attack immunifies for life or for years. The infectious agent may remain virulent for two years, and in certain cases it has been shown to last even longer. This will vary according to the conditions under which the infectious agent is placed.

Preventive Measures.

Prompt isolation is imperative. Special hospitals, to which the patient should be promptly transferred, should be provided. No public conveyances should be used for the transportation of the sick to the hospital.

The patient should be kept scrupulously clean, the body linen, etc., being often changed. Disinfectant washes should be used for the discharges from the mouth, nose, and eyes. Lint moistened with dilute disinfectant solutions can be applied to the skin, and when crusts form, carbolized oil, glycerin, or vaseline should be used to keep the epidermal scales from being scattered as dust. Isolation should be continued until the skin is perfectly normal (free from any trace of scabs).

Disinfection.

The precautions and methods of disinfection and isolation laid down in broad lines under the head of "Practical Directions" apply here.

24.—Suppuration, Septicæmia, and Pyæmia.

CAUSE: VARIOUS BACTERIA, THE MOST VIRULENT OF WHICH ARE THE PYOGENIC STREPTOCOCCI. THE FOLLOWING ORGANISMS MAY BE FOUND: STAPHYLOCOCCUS PYOGENES AUREUS, ALBUS, CITREUS, EPIDERMIDIS ALBUS, STREPTOCOCCUS PYOGENES, MICROCOCCUS TETRAGENUS, BACILLUS PYOCYANEUS, BACILLUS FŒTIDUS, ETC.

Mode of Infection, etc.

The infection may be spread through the fresh or dried secretions from infected wounds, which may adhere to all

kinds of objects about the patient—to instruments, hands of attendants, etc. Insects may act as carriers. Pathogenic bacteria are frequent on the body of healthy individuals and in the skin (staphylococcus epidermidis albus). They vary greatly in virulence, and the susceptibility of the patient varies also. Fresh secretions containing streptococci are most virulent. Secretions of abscesses, furuncles, phlegmons, empyema, osteo-myelitis, pyæmia, and progressive gangrene should be treated as infectious material. The pathogenic cocci may remain alive in a dry or moist state for one year or longer. As they withstand drying, they may float in the air as dust and gain access to wounds in a variety of ways. According to Sternberg, staphylococcus pyogenes aureus, citreus, and albus, and the bacillus pyocyaneus are killed by an exposure to moist heat at a temperature of 62° C. (143° F.) for ten minutes.

Preventive Measures.

Modern surgical technique has demonstrated the value of antisepsis so fully that it seems superfluous to enter upon the subject here. The disinfection to be carried out in the operating-room will be found on page 96. All bandages and objects which have become contaminated should be disinfected promptly. Patients suffering from septicæmia or pyæmia should be isolated.

Disinfection.

All wound dressings and bandages should be burnt, and other contaminated objects disinfected as noted in the text.

25.—Syphilis.

CAUSE : UNKNOWN.

Mode of Infection, etc.

Through various secretions coming in contact with abraded mucous membranes or skin. It is not known how long the infectious agent may remain virulent, but it is generally stated that the secretions must be fresh. As a rule acquired by coitus. Fournier and Ricord consider that about 25 per cent. of all cases of syphilis occurring in females, less so in males, are innocently or non-venereally acquired, and this in a variety of ways, as shown by reported cases (Bulkley). It does not seem out of place to mention some of these : (1) transmission in domestic life from articles used by syphilitic subjects, such as spoons, knives, forks, cups, glasses, tobacco-pipes, cigars ; wearing apparel, such as shirts, drawers, bathing-suits, and handkerchiefs ; from bedding and toilet articles, such as sponges, combs, tooth-brushes, syringes, pins, etc. ; (2) personal transmission, most frequently by kissing, also oc-

casionally by biting and scratching ; (3) in infants, besides being directly transmissible to the nurse or the infant, milk-bottles, sugar-teats, spoons, cups, etc., have been known to convey the disease ; (4) transmission may also occur in attendance on the sick ; either the physician or midwife may acquire the disease in the practice of their professions by contact with specific sores on various parts of the body, or the reverse,—that is, they may convey the disease directly or indirectly by instruments (many cases recorded in relation to the use of the Eustachian sound), specula, etc. Vaccination, tattooing, and ritual circumcision, as well as the removal of foreign bodies from the eye with the tongue, have been the means of communicating the disease. To repeat, all the modes of transmission already mentioned have been known to occur in well authenticated cases.

Preventive Measures.

Strict medical supervision of prostitution materially reduces the amount of syphilis, as has been strikingly demonstrated in barrack-towns. Sentimental ideas should not blind but open the eyes of the public to the necessity of regulations which will protect a large number of innocent persons who fall victims to the disease through the agency of those that have transgressed.

Regarding marriage in relation to this disease, the physician "should insist upon the necessity of two full years elapsing between the date of infection and the contracting of marriage. This, it should be borne in mind, is the earliest possible limit, and there should be at least a year of complete immunity from all manifestations of the disease" (Osler).

What has been said in the preceding column will plainly enough suggest other precautions, which conscientious individuals will at any rate attempt to observe.

Disinfection.

Burning, boiling, or chemical disinfection of any objects or dressings which have come in contact with infectious secretions.

26.—Tetanus (Lock-Jaw).

CAUSE: BACILLUS TETANI. F. P.

Mode of Infection, etc.

The spores of the tetanus bacillus are very generally distributed in the surface soil, and have been isolated also from the dust of streets and apartments, and from putrefying fluids and fæces. Soils from certain localities are particularly virulent. The wound secretions

from a tetanic man or animal, and everything that has come in contact therewith, are dangerous if the virus is introduced subcutaneously. Wooden splinters or earth getting especially into deep lacerated wounds are most frequently carriers of the infectious agent, which, moreover, has apparently to enter the body in a certain quantity to produce the disease.

The bacilli, both in culture and in dried secretions, assume the spore stage, in which they withstand drying for a long time. In some cases they have been found virulent after six months, and even after more than two years. The spores withstand dry heat at 150° C. (302° F.) for ten minutes, but are all killed off inside of eight minutes by moist heat at 100° C. (212° F.).

Preventive Measures.

Guard against the handling of bandages, etc., soiled by wound secretions. Tetanus in new-born children is usually due to infection through the navel and should be guarded against by antiseptic dressings of the latter, etc. Anything that may have become contaminated by wound secretions of a tetanic subject, including bedding, etc., should be carefully handled and disinfected. The necessity of prompt washing of wounds where dirt has entered as well as the removal of splinters, etc., and the

non-use of dirty rags, cobwebs, etc., on cuts should be brought home to the public.

Disinfection.

Dressings, etc., should be treated as in anthrax (p. 57).

27.—Trichiniasis.

CAUSE: TRICHINA SPIRALIS.

Mode of Infection, etc.

Infection occurs in man through the ingestion of improperly cooked pork containing encapsuled embryos. The capsules are dissolved in the alimentary canal and the trichinæ liberated. In about three days after ingestion the embryo reaches maturity, and in about a week produces hundreds of fully developed embryos, which pass through the intestines and reach the muscles, become encapsulated therein, and their development ceases. Through the process of calcification, which lasts four to five months in man, and at times years in the hog, the opaque, oat-shaped cysts become visible to the eye. Trichinæ have been known to develop after lying twenty-four years encapsuled in the system. Trichinæ occur in swine, rats, mice, and cats, and the disease is easily reproduced experimentally in rabbits and guinea-

pigs. In Northern Germany, where raw ham and sausage are much eaten, the disease occurs most frequently. Epidemics arising from the use of infected meat supplied from a common source have been frequently observed. From the fact that calcification of the capsules occurs very slowly in the hog the presence of trichinæ is overlooked. The flesh of hogs may contain an enormous number of embryos and the animals appear well nourished and healthy.

Preventive Measures.

Microscopical examination of samples of different muscles (abdominal muscles, diaphragm, intercostal muscles, muscles of the larynx and tongue) taken from each animal slaughtered should be required by law, as is the case in Germany. Thorough cooking of the meat containing trichinæ renders the same harmless. In large joints the centre may be insufficiently cooked and the disease be produced by the trichinæ therein. It should be remembered that salting and smoking give no assurance of protection. According to Heller, the parasite is killed by an exposure to 68° C. (155° F.).

If it has been discovered within twenty-four to thirty-six hours that the infected meat has been eaten purgatives of rhubarb and senna should be given, or an occasional

dose of calomel. Diarrhœa in the first days of infection is a favorable symptom (Osler, etc.).

28.—Tuberculosis.

CAUSE: BACILLUS TUBERCULOSIS. O. P.

Mode of Infection, etc.

The infection chiefly spread by the bacilli contained in the dried sputa of tuberculous individuals, which become pulverized and are inhaled. On account of the prevalence of the disease the bacilli are very generally distributed in the form of dust which can adhere to anything about the patient. Children playing about on carpets that have been contaminated with the sputa of tuberculous persons may inhale the bacilli in the dust. Bacilli have been found in the dust of ill-kept hospital wards, and may be scattered about on the street in the sputa. As many as four billion bacilli may be expectorated by a patient in twenty-four hours (Nuttall). Infection may occur through milk or meat of tuberculous animals. Salted meat may infect, as the bacilli are not affected by the process of salting. Direct inoculation may occur through sputa on clothes, etc., if they gain access to cuts in the hands, etc., in the process of washing. Tubercle bacilli can retain their virulence for five months

in dried sputum, and in sputum which has undergone putrefaction they may remain virulent for forty-three days.

Preventive Measures.

Isolation not being practicable, every other means of limiting the spread of the disease should be resorted to. Impress the patient with the importance of care on his part as a duty to others. The sputa, being the chief agent in spreading the disease, must be looked to. Kissing is to be avoided as a direct means of infection. If the sputa be small in quantity the patient can expectorate on pieces of toilet paper, which should be burnt promptly. The use of handkerchiefs for expectoration is to be condemned, as the sputa readily dry therein, and through friction in the pocket the infectious matter is converted into dust and scattered about. Sputum cups containing five per cent. carbolic solution (dangerous when the patient is delirious, as the contents may be swallowed), properly closed by a lid to prevent drying, as also the entrance of flies, should otherwise be used. The use of ordinary spittoons is to be avoided. Healthy persons should never be permitted to sleep in the same bed with a tuberculous individual. All handkerchiefs, linen clothes, etc., contaminated with sputa should be rendered sterile before being washed or handled. Tuberculous

patients should be provided with special eating utensils, which should be boiled after using. This should not be forgotten in hospitals where tuberculous patients are allowed to eat their meals together with others.

Tuberculous individuals should not be engaged about dairies. Tuberculous cattle should be slaughtered, and the possible spread of the disease in stables prevented by such an arrangement of the stalls that the animals cannot come in contact with each other, etc.

Disinfection.

Sputum cups and their contents are best disinfected by steam sterilization or boiling for half an hour. Boiling for five to ten minutes is insufficient to kill all the bacilli. Merely scalding the sputum cups is quite ineffectual. Fifteen grammes of sal soda to the litre of water in the sterilizer markedly facilitates the cleansing of the cups. When dried sputum is present on objects to be sterilized they should be exposed to moist heat at 100° C. for one hour. Eating utensils should be treated similarly, as badly washed cups, glasses, forks, etc., especially if roughened or jagged, might very well spread the disease. If five per cent. carbolic acid is used, add it in an equal volume, and mix it well with the sputum, letting it stand twenty-four hours. A shorter period is unsafe. The cup should be disin-

fected both on the inside and outside. Strong mineral acids are effectual, but disagreeable as well as dangerous to handle. Corrosive sublimate is ineffectual.

29.—Typhoid Fever.

CAUSE: BACILLUS TYPHI ABDOMINALIS. F. P.

Mode of Infection, etc.

The infection is spread through the dejections of the patient gaining access to the water supply. From this source various foods, vegetables and milk may become contaminated, the organisms multiplying readily in the latter. The bacilli may remain alive several months in the water-supply. They withstand drying for upwards of three months, and consequently might float in the air as dust. Linen and bedding may remain infectious for months. When putrefaction is not too active the bacilli withstand the process for three months. They are, moreover, relatively resistant to carbolic acid. The bacilli are destroyed (Sternberg) by an exposure to moist heat at 56° C., (138° F.,) for ten minutes.

Preventive Measures.

Where the disease is prevalent, only permit the drinking of boiled water or that which has been brought recently

from a source of known purity. Guard against contamination of any water supply by typhoid dejections. With this object, when in the country, where there is no proper sewerage, bury the dejections deep and far removed from the water supply. Dejections should always be disinfected until convalescence is well established.

The sick-room: No foods, such as milk, bouillon, meat, etc., should be left standing in the sick-room, as the bacilli multiply readily on gaining access to them. All vessels, feeders, cups, jugs, bedpans, etc., that are used for the patient, should be marked and kept entirely for the use of that patient, and should be cleaned by boiling. No discharges from the patient should be left under the bed; the bedpans should be promptly removed, and be provided with a cover. Mattresses and pillows, when liable to become soiled, should be protected with close-fitting rubber covers, and both linen and rubbers be immediately removed when soiled. Soiled linen should be handled as little as possible, and be placed in a pail at the bedside for immediate removal and disinfection as early as possible. After the patient has had a discharge cleanse the nates with toilet paper, and afterwards with compress cloth (moistened with one to four carbolic acid), and both are to be burnt. The attendant should disinfect his hands in three per cent. carbolic acid after they

have been in contact with any object about the patient which may have become contaminated.

Disinfection.

The discharges of the patient should be disinfected promptly—this being best accomplished by means of milk of lime, directions for the preparation and use of which will be found on pages 19 and 40 ; chloride of lime solutions (pages 20 and 41) are also recommended.

The handling of soiled linen, etc., has been considered on the preceding page—directions for the disinfection thereof, pages 13 and 38.

30.—Typhus.

CAUSE : UNKNOWN.

Mode of Infection, etc.

Highly contagious, the infectious matter is retained a long time in clothes and bedding. Unsanitary conditions, poverty, and crowding of persons promote the development of the disease.

Preventive Measures.

Isolation, especially in tents, is recommended, combined with complete and prompt disinfection of apartments, clothes, etc.

Disinfection.

See "General Directions." The disease is infectious in the first degree.

31.—Varicella (Chicken-pox).

CAUSE: UNKNOWN.

Mode of Infection, etc.

A contagious disease of childhood which occurs in epidemics or sporadically. (One attack does not afford protection against variola.)—(Osler.) Exact knowledge regarding the mode of infection is wanting.

Preventive Measures.

Isolation.

32.—Yellow Fever.

CAUSE: UNKNOWN.

Mode of Infection, etc.

There is no evidence that this disease is acquired through contact with the sick to a greater extent than cholera or typhoid. It can be carried by fomites. There is much that is obscure about yellow fever; namely,

its singular attachments, exhibiting a remarkable indifference to topographical and social conditions. There is no satisfactory evidence that the disease is contracted by the use of contaminated water (as in cholera and typhoid), whilst there is evidence that the atmospheric air acts as a carrier of the infectious agent (Sternberg). The most frequent agency in the dissemination of the disease from place to place is through yellow-fever patients, but as we do not know how they act as carriers, it is best to guard ourselves in every direction by a thorough system of disinfection.

One attack immunifies, as does also long residence in places where the disease is endemic—exceptions to this rule are rare.

Preventive Measures.

According to Sternberg, countries where the disease is not endemic should observe the following precautions; (1) exclusion of the exotic germ of the disease by sanitary supervision at the port of departure of ships sailing from infected ports, and thorough disinfection at the port of arrival when there is evidence or reasonable suspicion that they are infected; (2) isolation of the sick on shipboard, at quarantine stations, and, so far as practicable, in

recently infected places; (3) disinfection of excreta and of the clothing and bedding used by the sick and of localities into which the cases have been introduced or which have become infected in any way; (4) depopulation of infected places—that is, the removal of all susceptible persons whose presence is not necessary for the care of the sick. During an epidemic, individuals who remain in the locality should avoid the regions in which the disease prevails most; they should live temperately, avoiding all excesses, and should be careful not to get over-heated, either in the sun or by exercise (Osler). Time quarantine of ships and persons on board has been shown to be unreliable. The ship may remain infected indefinitely, and for this reason should be disinfected as soon as practicable. Healthy individuals should be removed from shipboard or the infected locality to a healthy place. Sanitary improvements in cities and vessels sailing from infected ports are most effectual (Sternberg).

Disinfection.

Excreta and articles soiled therewith should be disinfected—the same system being pursued as in typhoid fever (p. 92). Regarding the disinfection of ships see page 50.

SURGICAL DISINFECTION.[1]

(*a*) *Preparation of the Patient for the Operation.*

The patient is bathed the night preceding the day of operation, the part is shaved and covered with green soap for one to three hours, depending on the degree of sensitiveness exhibited by the patient. The soap is then washed off, if possible the whole body being bathed at the time, and the part well scrubbed with a brush to remove the layer of epidermis that has been acted on by the soap. This is followed by a moist dressing of corrosive sublimate (1 : 1,000) applied to the part until before the operation. In certain cases permanganate of potash and oxalic acid are applied as in hand disinfection. (Halsted).

For Gynæcological Operations (Kelly).

The patient is bathed daily for usually three days preceding operation. The last bath should be taken four to six hours before operation. The parts are scrubbed with soap and water, shaved, and washed with alcohol and ether (the alcohol to dehydrate and the ether to dissolve away fats). Finally the part is washed with 1 to 1,000

[1] Methods of disinfection employed in the Surgical Departments of the Johns Hopkins Hospital, Baltimore.

sublimate and a compress moistened with it placed over the part and covered with oiled muslin and a bandage. The process of disinfection, at times, including the use of permanganate of potash and oxalic acid is repeated before the operation.

(*b*) *Preparation of the Operator and his Assistants; Garments Worn; Sterilization of the Hands; Rubber Gloves.*

The clothes to be worn by the operator and assistants: White cotton suits fresh from the laundry, where they have been sterilized, should be used.

Preparation of the hands: The nails should be short and smooth. Scrub the hands and forearms well with soap and water (not less than 40° C., 194° F.) for five minutes; then place them in warm super-saturated aqueous solution of permanganate of potash, rubbing the skin well whilst in the bath, and keeping the parts therein until they are stained of a deep mahogany color (one minute usually); then decolorize completely in a warm, super-saturated, aqueous solution of oxalic acid, and finally wash off in sterilized salt solution or water.

Rubber Gloves are best sterilized by boiling five minutes in carb. soda solution. They are not injured thereby. They should be worn by the assistant who hands the

instruments. Finally the hands and forearms can be immersed in sublimate solution (1:1,000) for ten minutes.

(The action of these agents is chiefly one of oxidation, This is the only method of hand disinfection which has stood the test of recent bacteriological examination.)

(*c*) *Preparation of Operating Table and Room.*

No dust should be present in the room. All removal of dust should be done with a moist cloth or swab moistened with carbolic acid (five per cent.) or sublimate (1 : 1,000). No currents of air should be permitted; doors and windows should be kept shut.

(*d*) *Disinfection of Instruments and Vessels.*

Instruments are best sterilized by being maintained a half hour at 100° C. (212° F.) in the Arnold or other steam sterilizer. Rusting of instruments is prevented by their immediate removal from the sterilizer whilst hot.

Disinfection of instruments by means of one per cent. soda solution (Schimmelbusch)[1] maintained at boiling point for five minutes has also been used, and is applica-

[1] Behring showed that soda lye at 85° C (usually of the concentration 1.4%) invarably killed anthrax spores within ten minutes and often in less time. Schimmelbusch showed the pyogenic staphylococci and B. pyocyaneus to be killed by an exposure of three seconds to boiling 1% soda solution, and anthrax spores were killed in two minutes.

ble to all instruments except knives and needles, which are sterilized for two minutes at this temperature. The soda prevents rusting and increases the sterilizing power. The instruments are very slippery when removed from the soda solution, and it is well for this reason to rinse them in carbolic acid solution (five per cent.), after which they are placed in the trays containing carbolic acid solution (five per cent.) (Halsted).

The dishes in which the instruments are placed can (1) be filled, for one hour preceding the operation, with sublimate (1 to 500), or carbolic acid (five per cent.), these solutions being poured out and the dishes hal filled with sterilized water, into which the instruments are placed; or (2) dishes and instruments can be washed with hot water immediately after an operation, and disinfected before the next operation by being allowed to stand one hour filled with 1 to 40 carbolic acid. Vessels which contain salt solution should be disinfected with corrosive sublimate (1 to 1,000).

(*e*) *Dressings and Ligatures.*

Bandages, absorbent cotton, moss, and gauze should be exposed to a temperature of 100° C. (212° F.) for one hour in the steam sterilizer. Towels should be similarly

treated, and can be kept until needed in covered jars containing sublimate (1 to 1,000), or carbolic acid (three per cent.). Rubber protective should be placed for twenty-four hours before using in 1 to 1,000 sublimate.

Iodoform gauze prepared simply from sterilized gauze. As an occlusive dressing the following is used with sterilized gauze cut to proper sizes. ℞. Washed ether and absolute alcohol equal parts; recrystallized corrosive sublimate q. s. Anthony's snowy cotton. Add the cotton until the consistency of simple syrup is reached. Prepare carefully, avoiding as much as possible exposure to the air. Place in perfectly dry, wide-mouthed bottles before adding cotton.

Ligatures: Silk, silkworm-gut, and silver are placed in test-tube-like glasses plugged with cotton, the first being wound on glass spools. They are sterilized for one half hour on two consecutive days in the steam sterilizer. They can then be indefinitely preserved if kept dry to prevent the moulding of the plug. The latter can be burnt off before being withdrawn if it has been exposed to the dust.

Catgut should be kept reeled in absolute alcohol. Previous to using it, boil it in the water bath for half an hour. Do not use steam or oil as the catgut is rendered brittle.

(*f*) *Disinfectant and Sterile Solutions Employed and their Preparation.*

Carbolic acid, five per cent. ; sublimate, 1 to 1,000 ; for irrigation, normal salt solution (6 to 1,000) sterilized by heating over the flame until the boiling-point is reached, and then maintained at 100° C. (212° F.) for one hour (on three successive days) in the steam sterilizer to prevent too great an evaporation during sterilization. For washing, sterilized water may be used, being prepared in the same way as the normal salt solution.

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